The Orbiting Carbon Observatory-2 (OCO-2) Mission

Watching The Earth Breathe... Mapping CO_2 From Space

An Overview of NASA's Orbiting Carbon Observatory-2 (OCO-2)

Prepared by

David Crisp, Annmarie Eldering, and Michael Gunson

Jet Propulsion Laboratory, California Institute of Technology

*Lesley Ott, NASA Goddard Space Flight Center

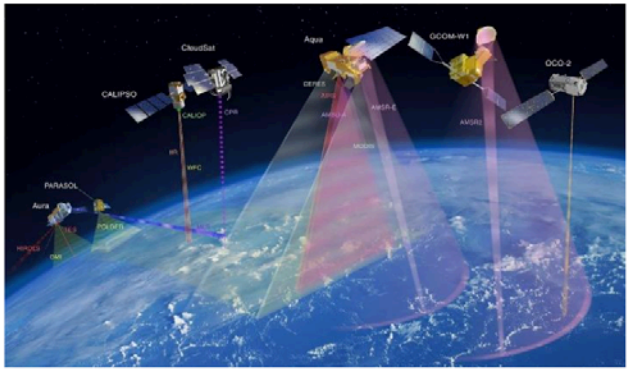
presenting for the OCO-2 Science Team

August 27, 2015

A Perfect Launch

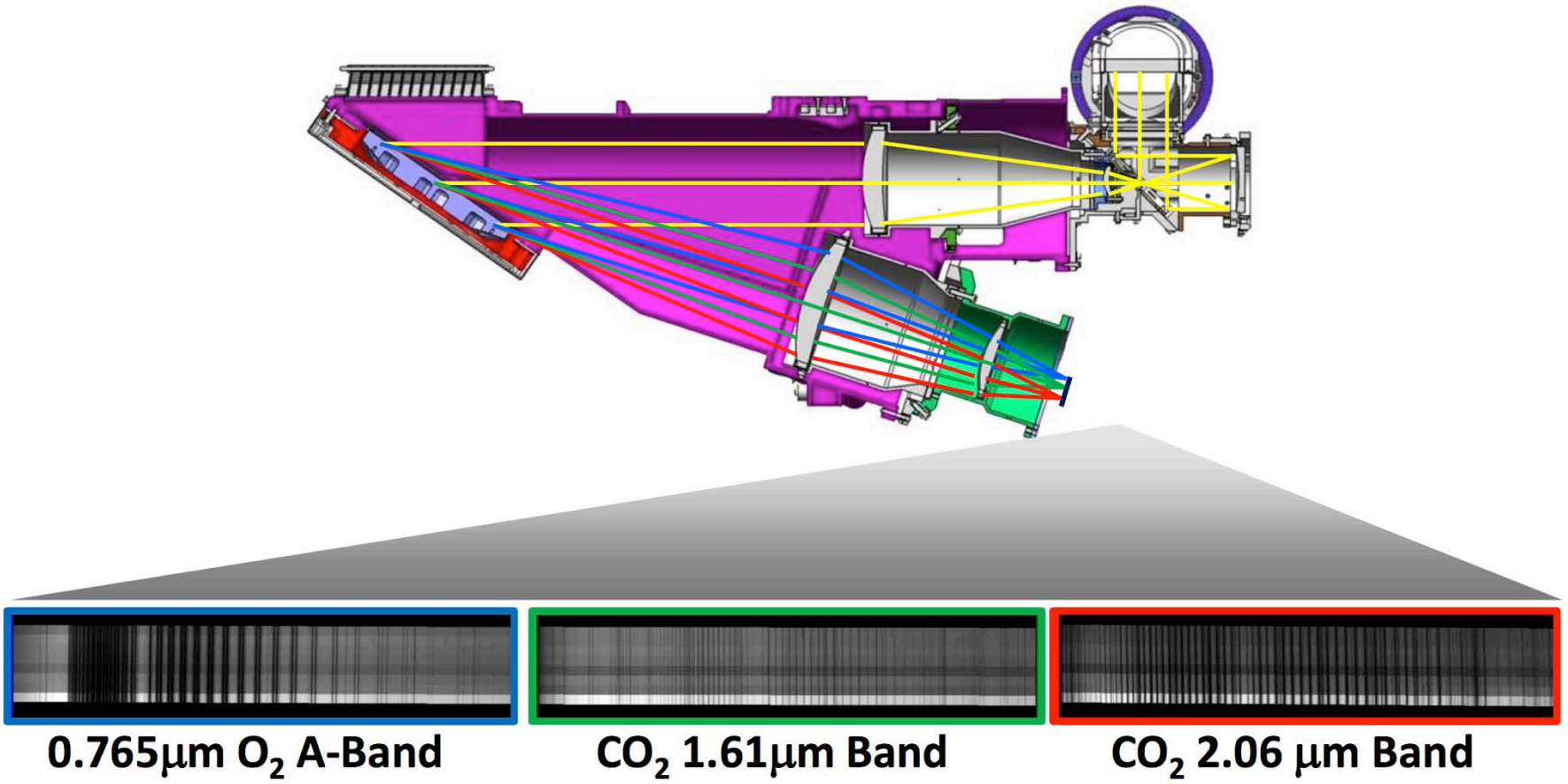
Lift-off at 2:56 am PDT, 02 July 2014

Separation!



Joining the A-Train
3 August 2014

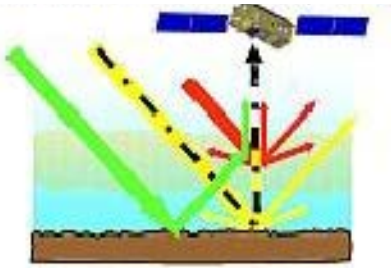
The OCO Instrument – Optimized for Sensitivity

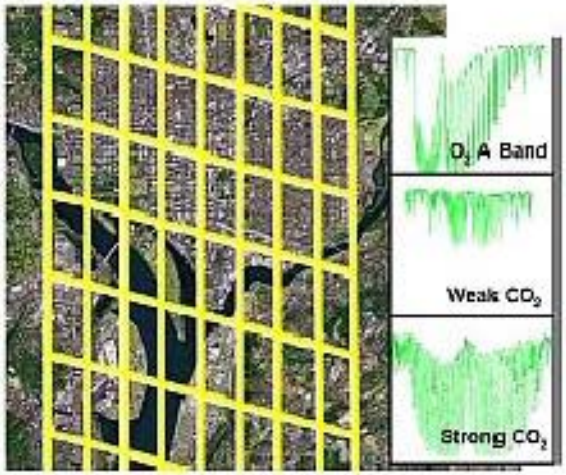


OCO-2 Observing Strategy

Nadir Observations:

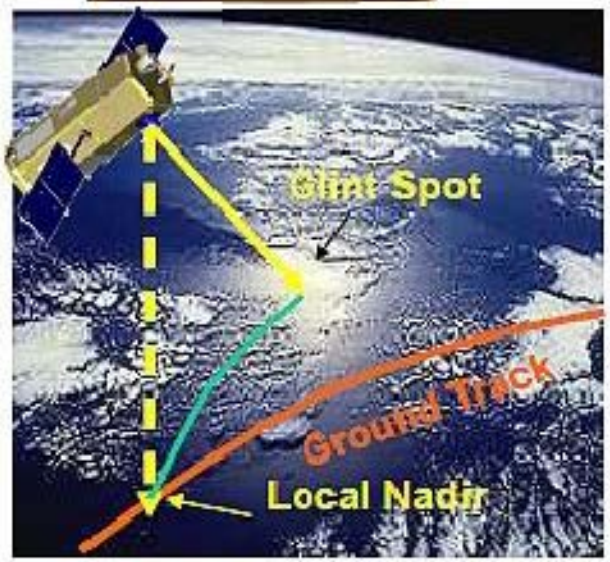
+ Small footprint (< 3 km^2)
- Low signal/noise over dark surfaces (ocean, ice)





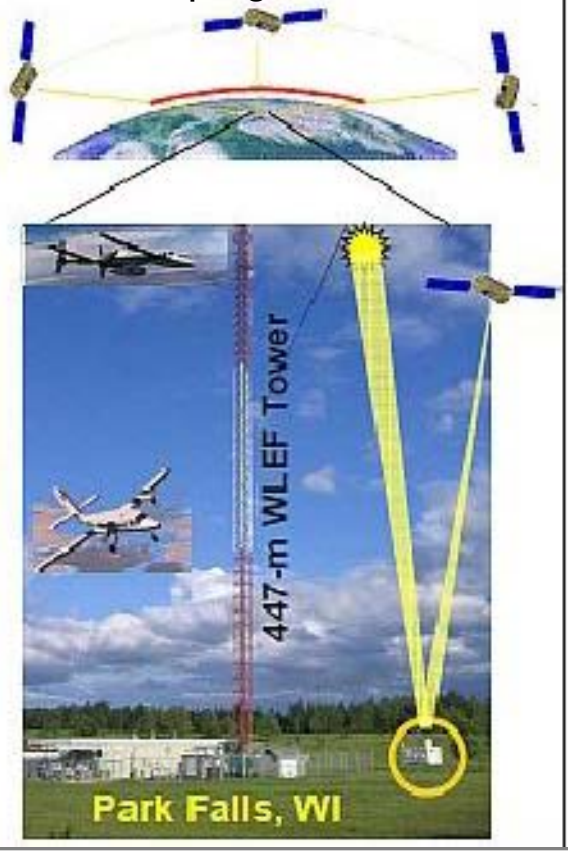
Glint Observations:

+ Improves signal/noise over oceans
- Potential for larger bias due to longer path

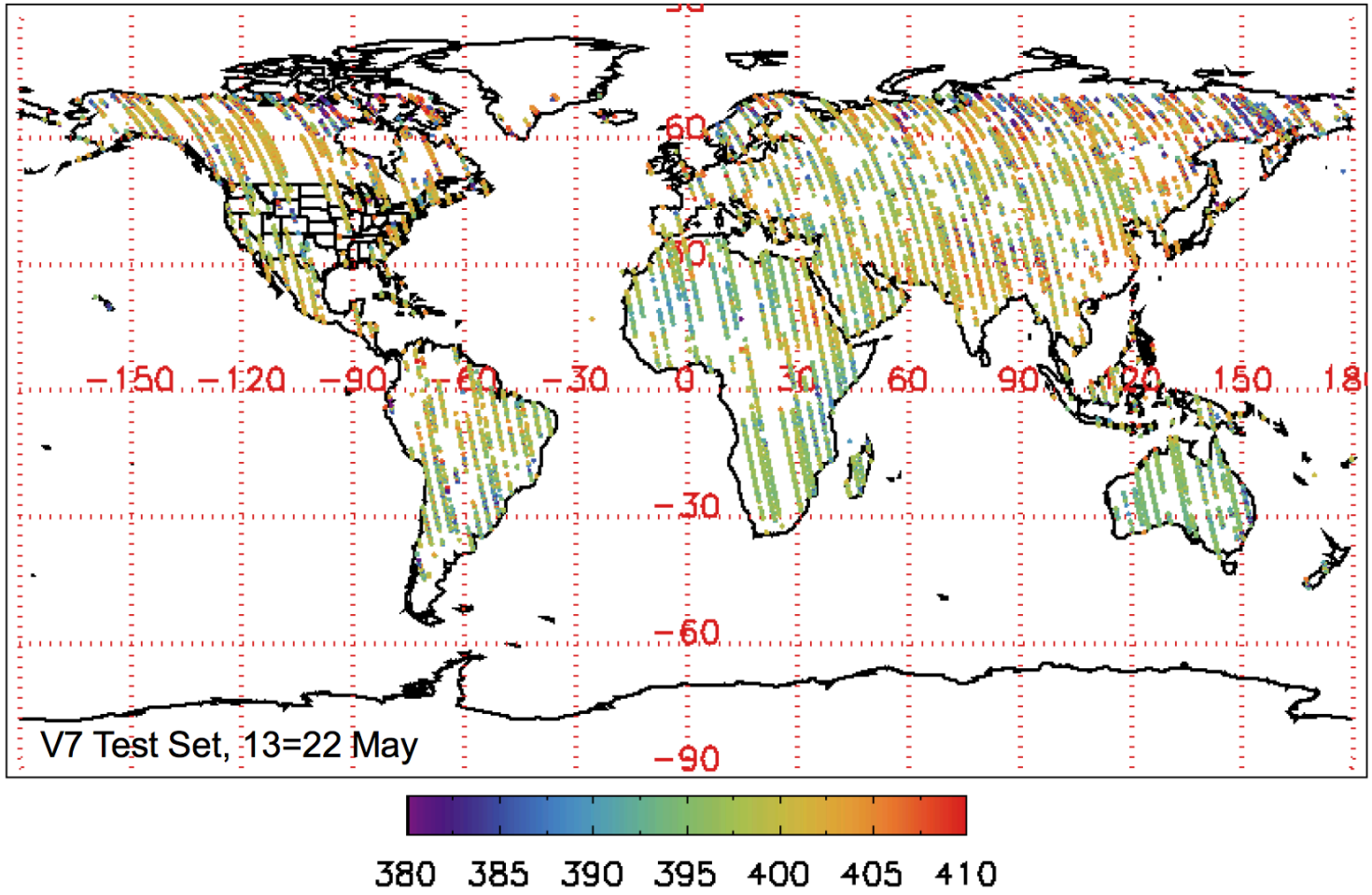


Target Observations:

Validation over ground-based FTS sites (TCCON), field campaigns

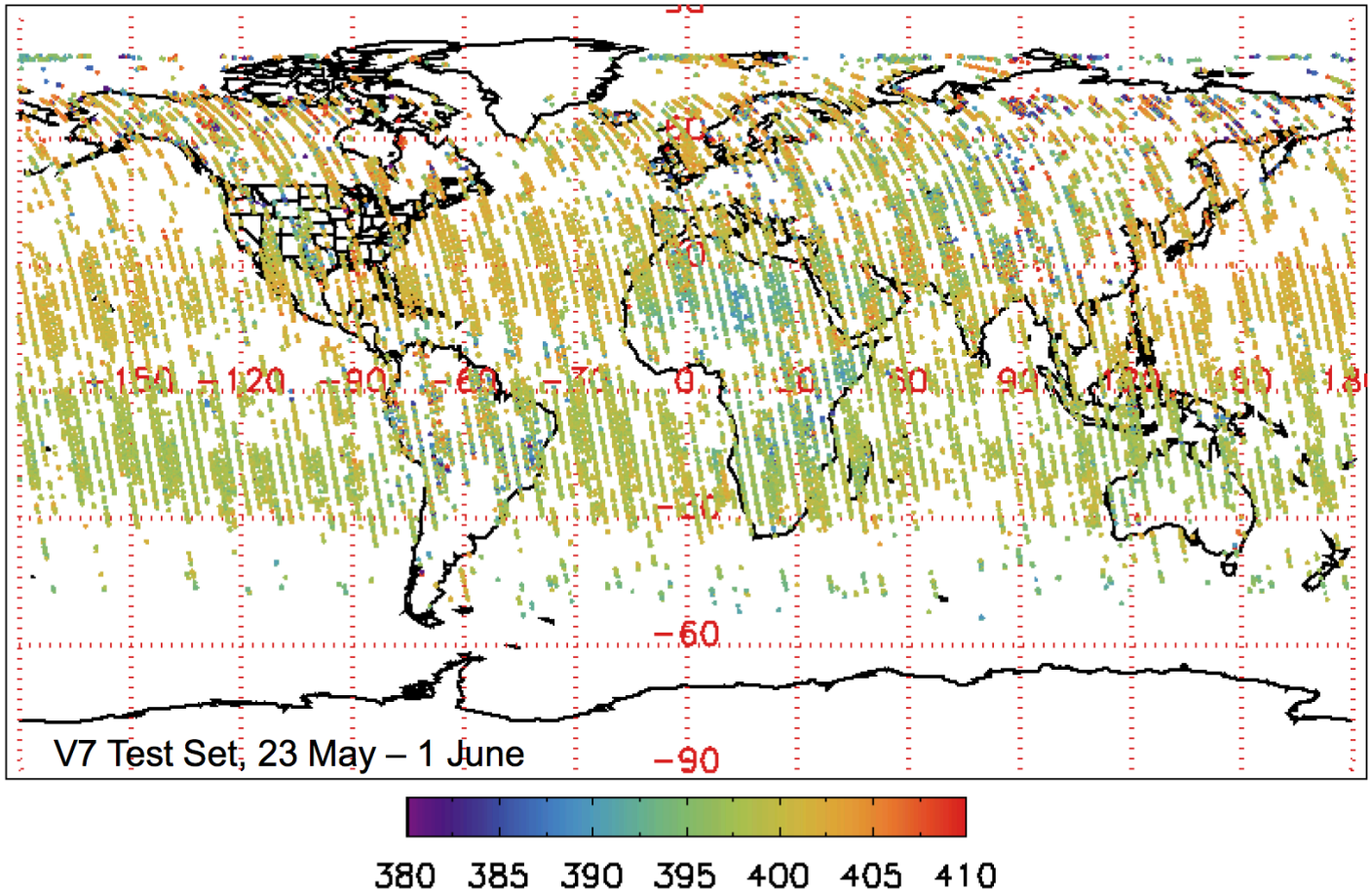


Preliminary Nadir Land XCO_2 Estimates



Nadir observations provide good coverage over land, but no coverage of ocean.

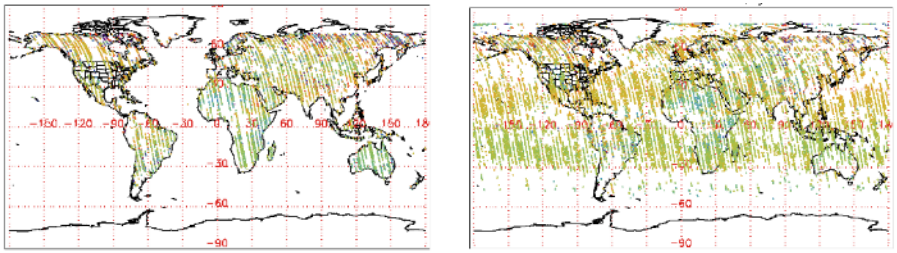
Preliminary Glint XCO_2 Estimates



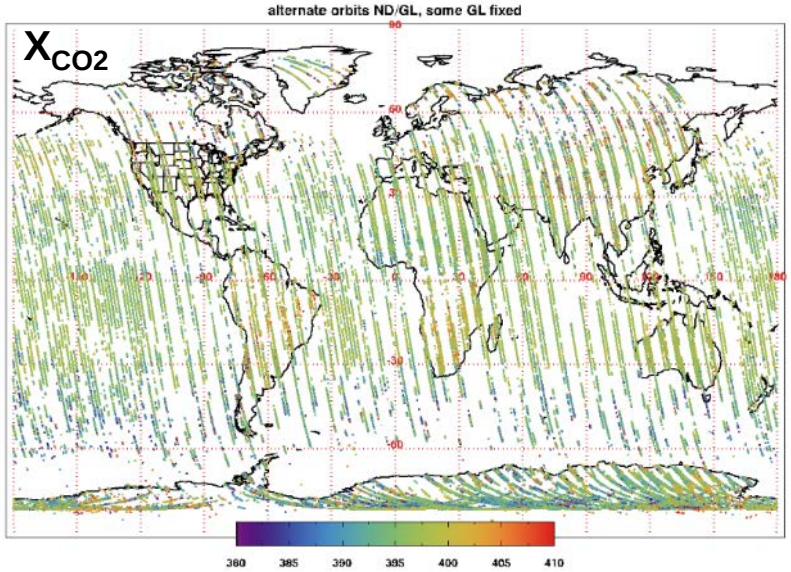
Glint observations provide better coverage of the ocean, but less coverage of high latitude land.

Changes in the Glint/Nadir Scheduling

Original Approach



Revised Approach

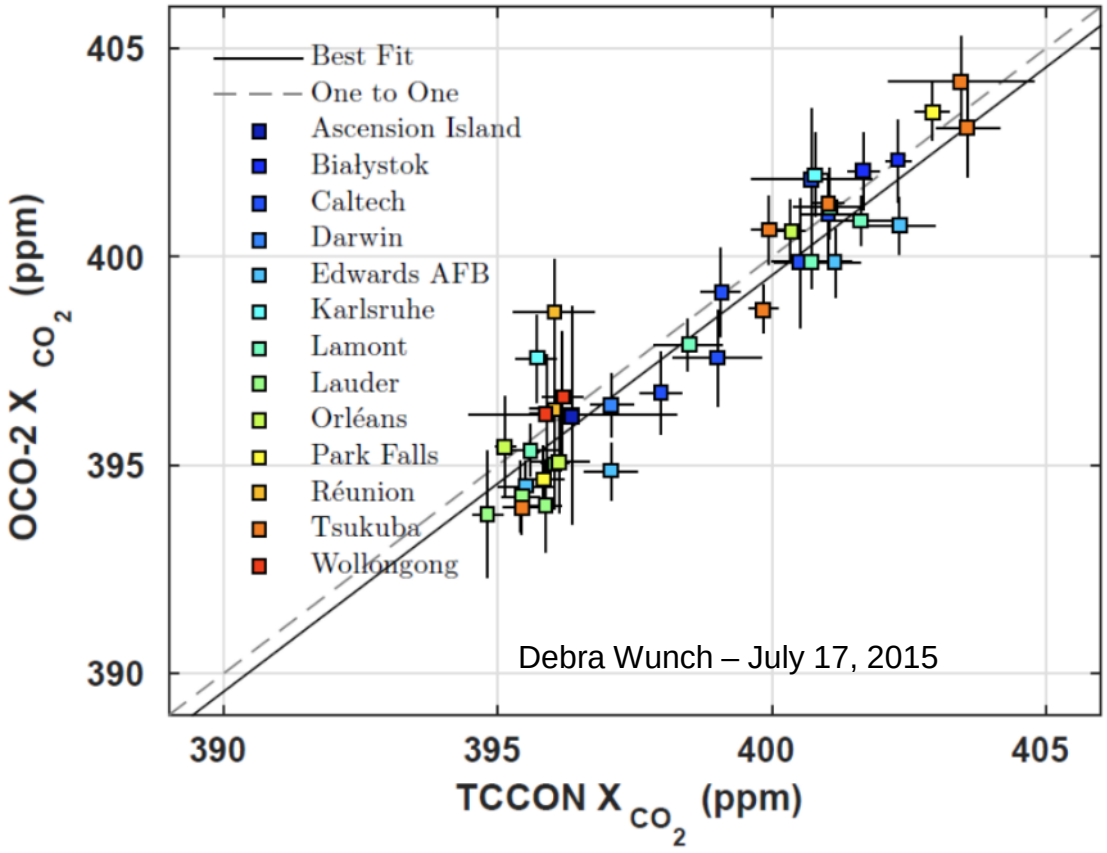


- Original sampling approach
  - Alternates between glint and nadir on successive 16-day ground repeat cycles
  - Precludes observations of oceans and high latitude continents for 16-day periods
- Revised glint/nadir strategy:
  - Step 1: Alternate between glint and nadir on successive orbits that include both land & ocean
  - Step 2: For orbits that are predominately over ocean, always stay in glint
- Changes implemented in early summer 2015

Target Observations – Validation of GOSAT and OCO-2 with TCCON

The Total Carbon Column Observing Network (TCCON) provides the primary means of validating GOSAT and OCO-2 products against WMO standards.

Comparison of TCCON and OCO-2 X_{CO2}

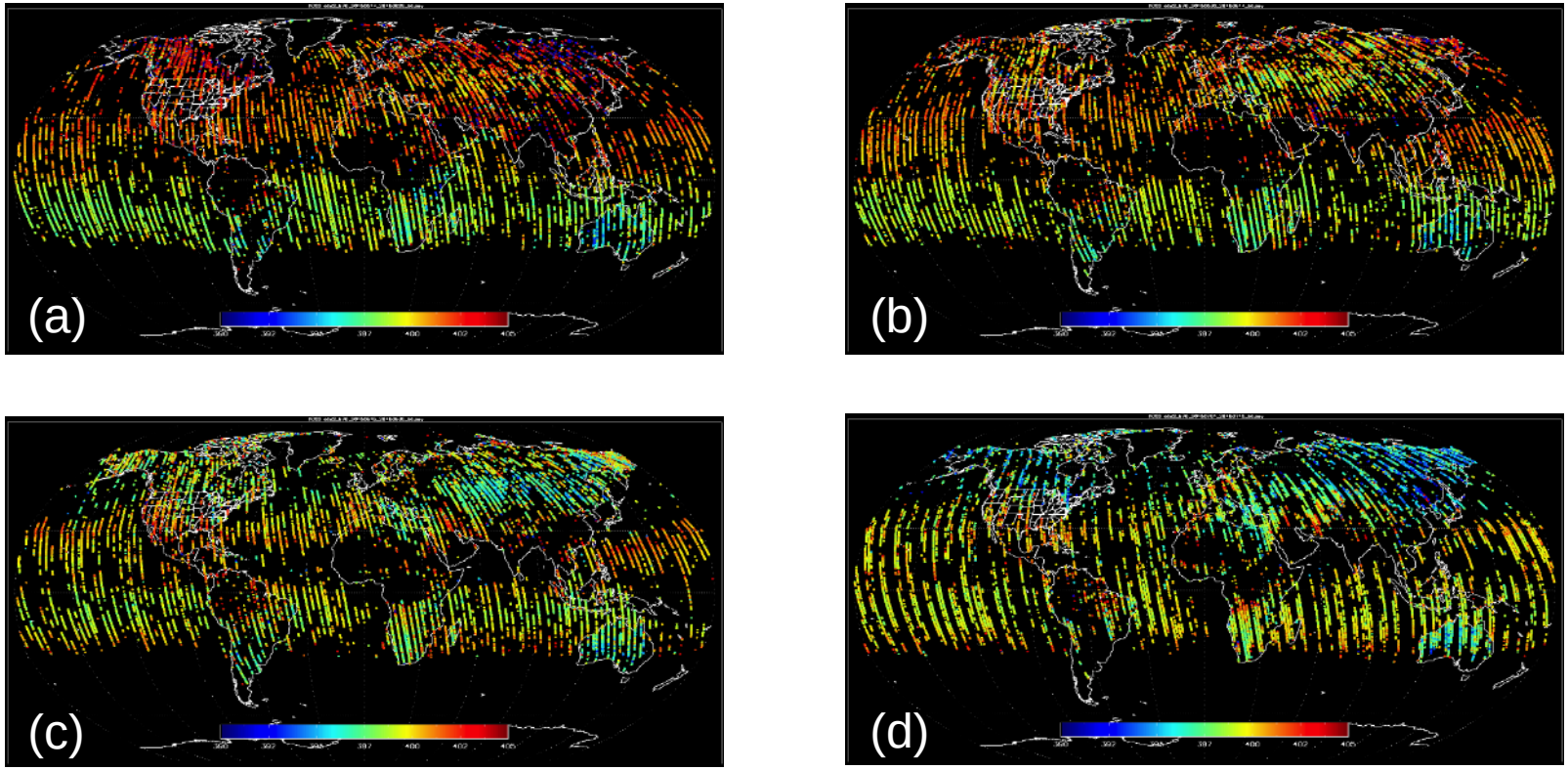


Comparisons with Total Carbon Column Observing Network (TCCON) stations are being used to identify and correct biases in target observations.

Initial differences between OCO-2 and TCCON X_{CO2} estimates were smaller than ~2 ppm (0.5%).

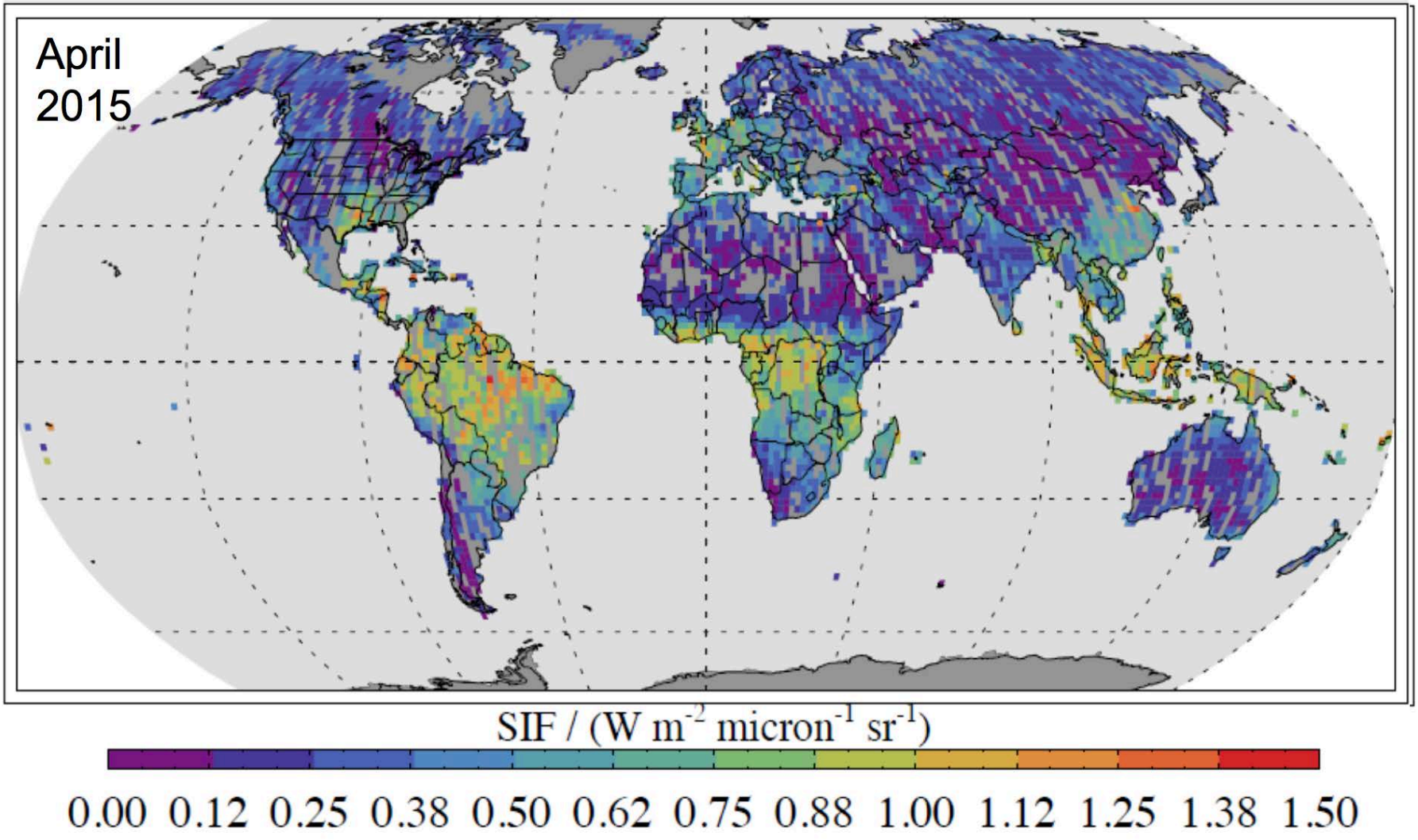
A preliminary bias correction further reduces these differences.

OCO-2 Observes the Spring Drawdown



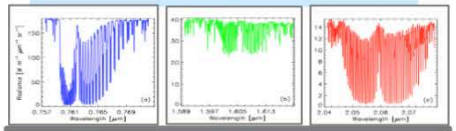
Global maps of the column-average CO_2 dry air mole fraction (X_{CO2}) for (a) 14-29 May, (b) 30 May to 14 June, (c) 15-30 June and (d) 1-15 July, produced from OCO-2 observations. The range of latitudes in the southern hemisphere is limited during this season because the sun is near it northernmost latitude. Large-scale reductions in X_{CO2} are clearly seen in the northern hemisphere, as the land biosphere becomes active and rapidly absorbs CO_2.

A New Product: Solar-Induced Chlorophyll Fluorescence (SIF)



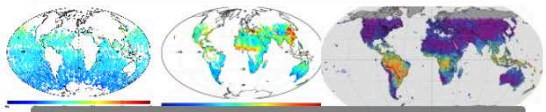
Initial OCO-2 Data Product Deliveries

L1B: Spectra



- oco2_L1bScND_89220a_1009
  - Dimensions
  - FootprintGeometry
  - FrameConfiguration
  - FrameGeometry
  - FrameHeader
  - FrameTemperatures
  - InstrumentHeader
  - Metadata
  - Shapes
  - SliceMeasurements
  - SoundingGeometry
  - SoundingMeasurements

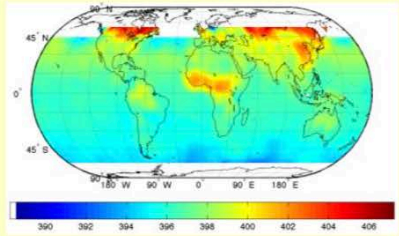
L2: XCO2, SIF, …



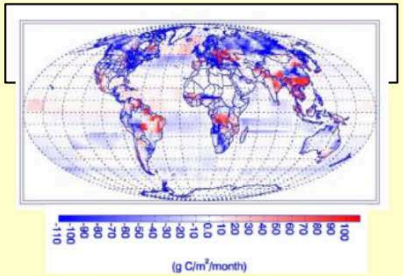
- oco2_L2StdND_89220a_100923_
  - AerosolResults
  - AlbedoResults
  - Dimensions
  - DispersionResults
  - L1bScSoundingReference
  - Metadata
  - PreprocessingResults
  - RetrievalGeometry
  - RetrievalHeader
  - RetrievalResults
  - Shapes
  - SpectralParameters

Mapped Products

L3: X_{CO2} Maps



L4: Fluxes



December 30, 2014 — March 30, 2015 — As Available

http://disc.sci.gsfc.nasa.gov/OCO-2/data-holdings/oco-2-v7

Summary

- OCO-2 was successfully launched on July 2, 2014 and began routine operations in early September 2014
  - Now returning about 1 million observations per day over the sunlit hemisphere
  - Between 10% (nadir) and 25% (glint) of these measurements are sufficiently cloud-free to yield accurate estimates of XCO_2
- The Build 7/7r data products are being delivered to the GES-DISC
  - Reprocessing back to September 6 2014 completed
  - V7 has no sounding (down)selection, warn levels, or bias correction
  - Bias corrections and warn levels currently under development
    - An airmass bias in glint is currently receiving most of the attention
- An intermediate product (B7.1) that includes warn levels and a recommended bias correction will be delivered before the end of September, along with a “Lite” product